A new species of *Striostrea* (Bivalvia: Flemingostreidae) from the upper Pliocene and lower Pleistocene strata of Florida, USA

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ABSTRACT

Faunal studies of the Tamiami and Caloosahatchee formations (upper Pliocene to lower Pleistocene) in southern peninsular Florida have revealed a new crassostreine oyster, *Striostrea paucichomata* Bolton new species. Although similar in appearance, this bivalve differs from *Crassostrea virginica* (Gmelin, 1791) by having weakly developed chomata (not visible in about 30% of the specimens examined), the right valve having a riblet-bearing surficial layer (visible only on exceptionally well-preserved specimens), and an adductor muscle attachment that is situated more dorsally. The geology of the type area of *S. paucichomata* in northern Sarasota County, and a stratigraphic nomenclatural history of the Tamiami and Caloosahatchee formations are reviewed. A key to Cenozoic crassostreine oysters known from the southeastern United States is also provided. The following new generic placements are proposed for four previously named species: *Myrakeena sculpturata* (Conrad, 1840) **new combination**, *Myrakeena lawrencei* (Ward and Blackwelder, 1987) **new combination**, *Myrakeena greeni* (Ward, 1992) **new combination**, *Undulostrea locklini* (Gardner, 1945) **new combination** and *Striostrea cahobasensis* (Pilsbry and Brown, 1917) **new combination**.

Additional Keywords: Mollusca, Crassostreinae, *Striostrea gigantissima* (Finch, 1824), *Conradostrea*, Fossil

INTRODUCTION

Investigations of two mounds of construction fill in Manatee County, Florida (the fill probably originated from northern Sarasota County quarries) in 1996 and 1998, which contained molluscan fauna typical of the Pinecrest beds of the Tamiami Formation (upper Pliocene to lower Pleistocene), revealed a crassostreine oyster species different from *Crassostrea virginica* (Gmelin, 1791) and herein described as *Striostrea paucichomata* Bolton new species. A review of published faunal lists for crassostreine oysters from the Pliocene and early Pleistocene of Florida found only *C. virginica* (see Mansfield, 1932, 1939; Olsson and Harbison, 1953; DuBar, 1958, 1962; Stanley, 1986; Campbell, 1993). Examination of the extensive fossil collections at the Florida Museum of Natural History (FLMNH) found that *S. paucichomata* is a common component of the Tamiami Formation and also present in the Caloosahatchee Formation (lower Pleistocene) in southern peninsular Florida. All of the type, figured and referred specimens are deposited in the University of Florida, Florida Museum of Natural History, Invertebrate Paleontology Collection and are cataloged with the prefix UF and a lot number.

Specimens of *Striostrea paucichomata* found in the Tamiami Formation were commonly found in association with the oysters *Hyotissa haitensis* (G.B. Sowerby I, 1850), *Ostrea compressirostra* Say, 1824, and *Myrakeena sculpturata* (Conrad, 1840) **new combination**. Oysters less commonly associated with *S. paucichomata* were *Undulostrea locklini* (Gardner, 1945) **new combination**, *C. virginica*, *Cubitostrea coxi* (Gardner, 1945), and *Dendostrea frons* (Linnaeus, 1758). *Myrakeena sculpturata* was placed in the genus *Conradostrea* Ward and Blackwelder, 1987 along with *Myrakeena lawrencei* (Ward and Blackwelder, 1987) **new combination** and *Myrakeena greeni* (Ward, 1992) **new combination**. The diagnostic shell characters of *Conradostrea* are the same as those of *Myrakeena* Harry, 1985 and therefore *Conradostrea* should be considered a junior synonym of *Myrakeena*. The shell morphology of *U. locklini* is consistent with the description of *Undulostrea* Harry, 1985 and therefore should be included in that genus. *Myrakeena* and *Undulostrea* have similar spatial and temporal distributions as the genus *Placunanomia* Broderip, 1832 (Anomiidae Rafinesque, 1815). These three genera inhabited the eastern Pacific and western Atlantic in the Pliocene and became extirpated from the western Atlantic by the middle of the Pleistocene with one or two species still extant in the eastern Pacific [*Myrakeena angelica* (Rochebrune, 1895); *Undulostrea megodon* (Hanley, 1846); *Placunanomia cumingii* Broderip, 1832; *Placunanomia panamensis* Olsson, 1942].

Stenzel (1971: N1128) in his revision of the oysters stated that fossil crassostreines (as nonincubatory genera within the subfamily Ostreinae) "are recognized by their left valve umbonal cavity and similarity to living *Crassostrea*". Harry (1985: 149) in his revision of the living oysters recognized the subfamily Crassostreinae proposed by Torigoe (1981) and characterized the shells as "medium to large size, usually elongated dorsoventrally, occasionally subcircular. The left valve is usually deeply concave, and the right one is usually nearly flat. Shell plications are usually limited to the left valve, often indifferently developed or absent. The early part of the right valve exterior has continuous growth of the outer shell layer, and later it often forms fragile, appressed, overlapping lamellae, but the outer surface is frequently eroded during life, obliterating the sculpture. The chomata are ostreine, or absent. The muscle scars tend to be more darkly colored than the surrounding shell, in one or both valves."

Stenzel (1971) and Harry (1985) listed the presence of a riblet-bearing surficial layer on the right valve and the presence of chomata as characters that separate *Striostrea* from *Crassostrea*. Stenzel (1971) described the riblet-bearing surficial layer as: "This layer is thin and delicate and flakes off readily. In fossil species, only a few exceptionally well-preserved specimens retain it on the outer face of the right valve (see Fig. 107,1c). Commonly the layer is dark-colored because it is either made entirely of conchiolin or is a prismatic calcite layer rich in conchiolin. Riblets are restricted to this surficial layer, and the immediately underlying, more calcareous and lighter-colored layer shows a faint trace of them at best. Because of its delicate consistency the riblet-bearing layer is better preserved in very young and still fragile oyster shells and dehisces in older individuals. Old individuals may show riblets only on the marginal conchiolin fringes." (p. N979) and "Right valve covered by many thin, readily dehiscent, conchiolin-rich imbricating layers that have prismatic shell structure and carry on their tops many narrow (1.3 mm. or less wide) dichotomous flat-topped radial riblets separated by narrower interspaces, riblets converging and diverging irregularly from place to place, producing shaggy appearing surface, becoming less abundant and less prominent in later growth stages." (p. N1136).

Stenzel (1971: N979) provided *Striostrea alabamiensis* (I. Lea, 1833) as an example of an extinct species of *Striostrea* based on the description and illustrations in Harris (1919). *Striostrea alabamiensis* is actually a synonym of *Striostrea gigantissima* (Finch, 1824) as proposed by Harris (1919) and Lawrence (1995: 193). Harris (1919) thought that Finch's description was not sufficient to be valid. Howe (1937) argued that Finch's description was as informative as those of some of his contemporaries and should be considered valid. Other extinct crassostreine species with a riblet-bearing surficial layer based on the literature include *Ostrea dorsata* Deshayes, 1824 (Deshayes, 1824; J.D.C. Sowerby, 1850; Wood, 1861–1871), *Ostrea spatulata* Lamarck, 1806 (Deshayes, 1824), *Ostrea tenera* J. Sowerby, 1821 (J.D.C. Sowerby, 1850; Wood, 1861–1871), *Ostrea velata* Wood, 1861 (Wood, 1861–1871) and *Crassostrea cahobasensis* (Pilsbry and Brown, 1917) (Woodring, 1982).

Lawrence (1995) argued that all of the crassostreine genera should be included in *Crassostrea*. Part of his argument was based on the presence of chomata on *C. gigantissima* and *C. cahobasensis* and a riblet-bearing surficial layer on *C. gigantissima*. However, since both of these species have chomata and a riblet-bearing surficial layer and since these are currently considered diagnostic characters for the genus *Striostrea*, then at least for *Striostrea* his argument is not valid.

Carter et al. (2011) proposed placing the crassostreine oysters in the family Flemingostreidae Stenzel, 1971. According to Carter et al. (2011), this family contains the extinct paraphyletic subfamilies Flemingostreinae Stenzel, 1971 and Liostreinae Vialov, 1983 and the extant subfamily Crassostreinae Scarlato and Starobogatov, 1979. The living crassostreine oysters were originally placed in their own family (Crassostreidae) by Scarlato and Starobogatov (1979: 46) on the basis: "Non-incubating oysters, because of the presence in them of such morphological structures as a promyal cavity (promyal passage) and peculiarities of reproduction" and "The family is characterized by the development of a promyal cavity, the pericardium shifted before the adductor muscle anteriorly, and to the right, and the union of the anterior part of the suprabranchial cavity with its excurrent part. In the left (attached) valve there is usually a deep subumbonal cavity. The eggs develop internally, the sexes are separate (possibly protandric hermaphrodites, but with a regular and complete sex change phase)." In order to include the Flemingostreinae and Liostreinae in the same family-group rank with the Crassostreinae, the obligate choice for family name was Flemingostreidae (Nikolaus Malchus, personal communication). See synonymy list under the systematics section.

OCCURRENCES, STRATIGRAPHY, AND AGE

Over forty complete valves (some paired) of *Striostrea paucichomata* Bolton new species have been examined in the FLMNH Invertebrate Paleontology Collections. All were derived from the two most densely-packed and species-rich molluscan units of southern Florida; namely the Pinecrest beds of the Tamiami Formation and the Caloosahatchee Formation. The majority was recorded from the Pinecrest beds in northwestern Sarasota County with the remainder collected from Broward, Charlotte, De Soto, and Hendry counties (see Figure 1).

Much confusion and controversy surround surface and near-surface deposits (especially the Tamiami Formation) of southern Florida. As summarized by Jones (1997: 107) this is because "Pliocene and Pleistocene deposits in the region consist of siliciclastic and carbonate lithologies whose lateral and temporal relationships are obscured by 1) thinness and discontinuous distribution of units, 2) limited exposures, 3) rapid facies changes, and 4) repeated advance and retreat of the sea over this low-elevation region in response to the many sea-level oscillations of the Plio-Pleistocene". Additionally, many stratigraphic units have been erected not based on lithology (as now required by the North American Stratigraphic Code) but fossil content (Scott, 1992).

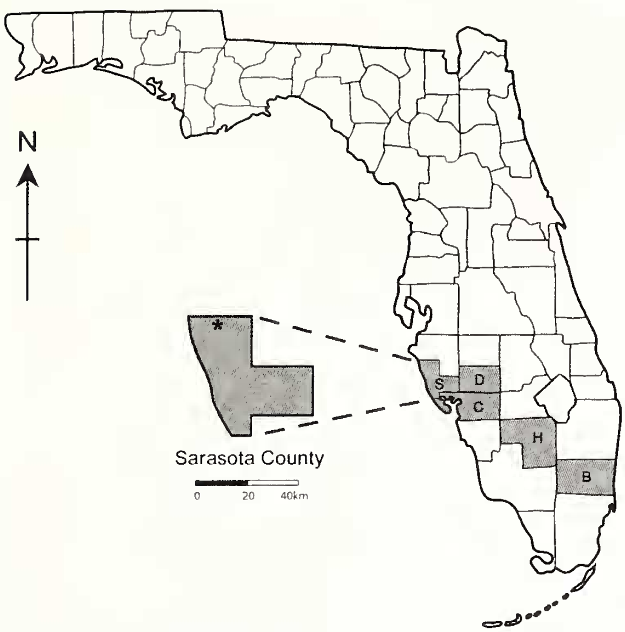


Figure 1. Florida map showing *Striostrea paucichomata* Bolton **new species** type area (depicted by *); equals now defunct APAC Sarasota Mines (formerly Macasphalt Shell Pits, Newburn Road Pit, Warren Brothers Pits) and active SMR Aggregates Pits (formerly Wendell Kent Pit, Richardson Road Shell Pits, Quality Aggregates Shell Pits). All counties – Sarasota (S), De Soto (D), Charlotte (C), Hendry (H) and Broward (B) where occurrences are known are shaded.

Herein, we use widely-accepted stratigraphic terminology for both units (Tamiami and Caloosahatchee formations) in which *S. paucichomata* is known to occur (e.g., Zullo and Harris, 1992). For a more thorough review of southern Florida stratigraphy refer to Lyons (1991).

The name "Tamiami limestone" was first applied by Mansfield (1939) for deposits exposed during road construction in Collier and Monroe counties. Parker and Cooke (1944) broadened the concept of the Tamiami limestone and designated it a formation. They also included the sands near Pinecrest, as described in Mansfield (1931), in their concept and concluded that the Buckingham limestone of Mansfield (1939) was a facies of the Tamiami Formation. Parker (1951) placed the Buckingham limestone in the Tamiami Formation, and Olsson (1964) informally proposed the "Pinecrest beds" for fossil deposits younger than the Tamiami Formation and older than the Caloosahatchee marl. Hunter (1968) divided the Tamiami Formation into five, major, members based on lithostratigraphy; Bayshore Clay, Murdock Station member, Pinecrest sand, Ochopee limestone, and Buckingham limestone. She considered the three youngest members, the Pinecrest sand, Ochopee limestone, and Buckingham limestone, to be lateral equivalents; her oldest member being the Bayshore clay. However, Missimer (1992, p. 63) reported that the Tamiami Formation "consists of at least nine mappable members or facies" including the Pinecrest Sand, Ochopee Limestone and Buckingham Limestone. Due to the poorly defined, lithologically (carbonates, siliciclastics, and mixed siliciclastics-carbonates), and temporally complex nature of the Tamiami Formation, Zullo and Harris (1992) employed sequence stratigraphy to help unravel both its temporal and spatial relationships. For the purposes of this study we follow their nomenclature of this marine deposit, especially in the type area of *S. paucichomata* (Figures 1 and 2).

Today, the Pinecrest beds are best exposed at Schroeder-Manatee Ranch Aggregates, Inc. (SMR) excavations (formerly Richardson Road Shell Pits and Quality Aggregates Shell Pits) in Sarasota County (Figure 1); now that the more westward Ashland Petroleum and Asphalt Corporation (APAC) Sarasota pits (formerly Newburn Road Pit, Warren Brothers Pits, and Macasphalt Shell Pits) are water-filled. At APAC, Petuch (1982) divided the exposed beds into twelve units. Based on the aforementioned sequence stratigraphic analysis of Zullo and Harris (1992) at APAC and SMR, they concluded that Petuch Units 0–1 belong to the Caloosahatchee Formation and Units 2–11 were Tamiami Formation. Units 2–9 were divided into the Upper Tamiami Formation and Units 10–11 were Lower Tamiami Formation. Further subdivision placed Units 2–3 into the upper Pinecrest beds and Units 4–9 into the lower Pinecrest beds (see Figure 2). Herein, we follow the stratigraphic organization proposed Zullo and Harris (1992) although Petuch and Drolshagen (2011) now consider Units 2–4 to belong to the Fruitville Member (Tamiami Formation), Units 5–9 to belong to the Pinecrest Member (Tamiami Formation), Unit 10 to belong to the Buckingham Member (Tamiami Formation), and Unit 11 to be the Sarasota Member (Murdock Station Formation).

Jones et al. (1991) estimated the age of Petuch's (1982) Units 2–4 as being 2.25 (+/– 0.25) Ma and Units 5–10 as being 3.0 (+/– 0.5) Ma based on $^{87}Sr/^{86}Sr$ isotope bivalve dating, paleomagnetism, and invertebrate and vertebrate biochronology. Allmon (1993) concluded that Units 5–10 are upper Pliocene (3.0–3.5 Ma) and Units 2–4 are much younger (2.0–2.5 Ma). Gibbard et al. (2009) places the boundary between the Pliocene and the Pleistocene at 2.588 Ma. Therefore, Units 2–4 with a minimum age of 2.0 Ma and maximum age of 2.5 Ma is lower Pleistocene. Units 5–10 with a minimum age of 2.5 Ma and a maximum age of 3.5 Ma is mostly, if not wholly, upper Pliocene. The underlying Unit 11 is therefore at least upper Pliocene.

The name "Caloosahatchee beds of marls" was applied by Dall (1887) for shell horizons exposed along the Caloosahatchee River. Matson and Clapp (1909) later referred to the unit as "Caloosahatchee marl" and DuBar (1974: 216) elevated it to formational status because "of the diversity of lithologies and the vagueness of the term marls". Today, the southern peninsular Florida marine, brackish, and freshwater units which are younger than the Tamiami Formation and older than the Bermont Formation are placed within this unit (DuBar, 1974).

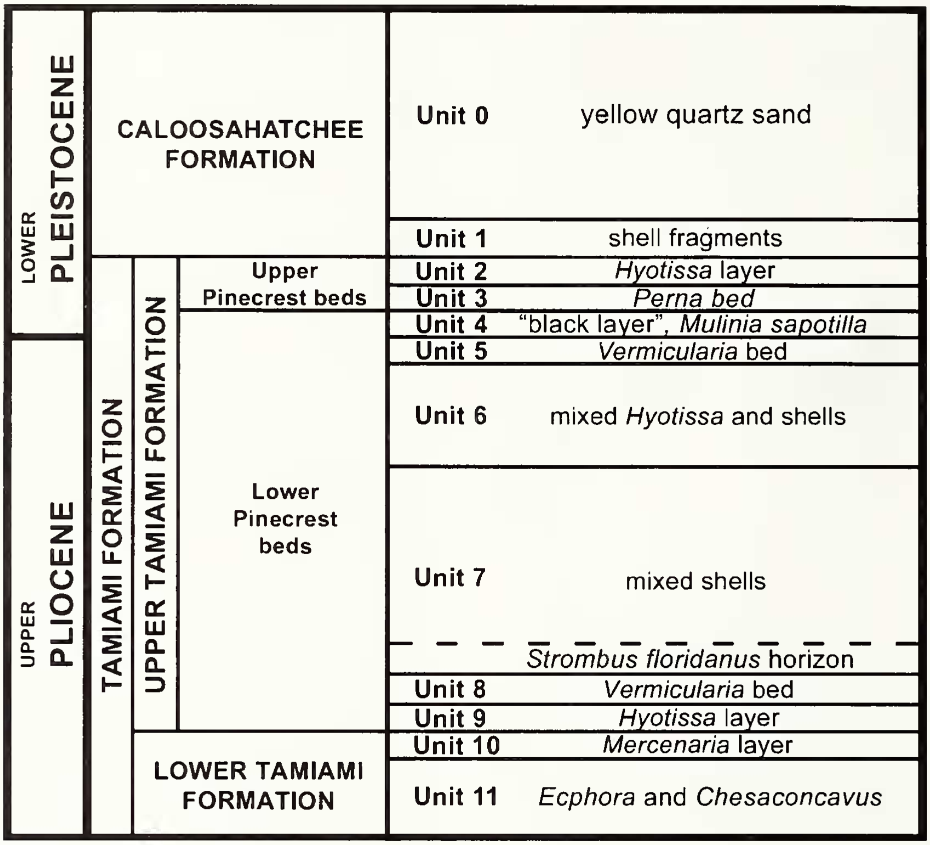


Figure 2. Stratigraphic nomenclature for the type area of *Striostrea paucichomata* Bolton **new species** in Sarasota County modified from Zullo and Harris (1992) and incorporating stratigraphic units of Petuch (1982). The new species has thus far been recorded from Units 3, 5 through 8 and 10.

The Caloosahatchee Formation disconformably overlies the Tamiami Formation and has been estimated to be about 1.8 Ma using He/U coral dating (Muhs et al., 1992). This places the unit in the late lower Pleistocene.

SYSTEMATICS

Class Bivalvia Linnaeus, 1758
Order Ostreida Férussac, 1822 in 1821–1822
Superfamily Ostreoidea Rafinesque, 1815
Family Flemingostreidae Stenzel, 1971
 Flemingostreini Stenzel, 1971
 Crassostreidae Scarlato and Starobogatov, 1979
 Crassostreini Chiplankar and Badve, 1979
 Crassostreinae Torigoe, 1981
 Crassostreinae Freneix, 1982
 Liostreinae Vialov, 1983
Subfamily Crassostreinae Scarlato and Starobogatov, 1979
Tribe Striostreini Harry, 1985

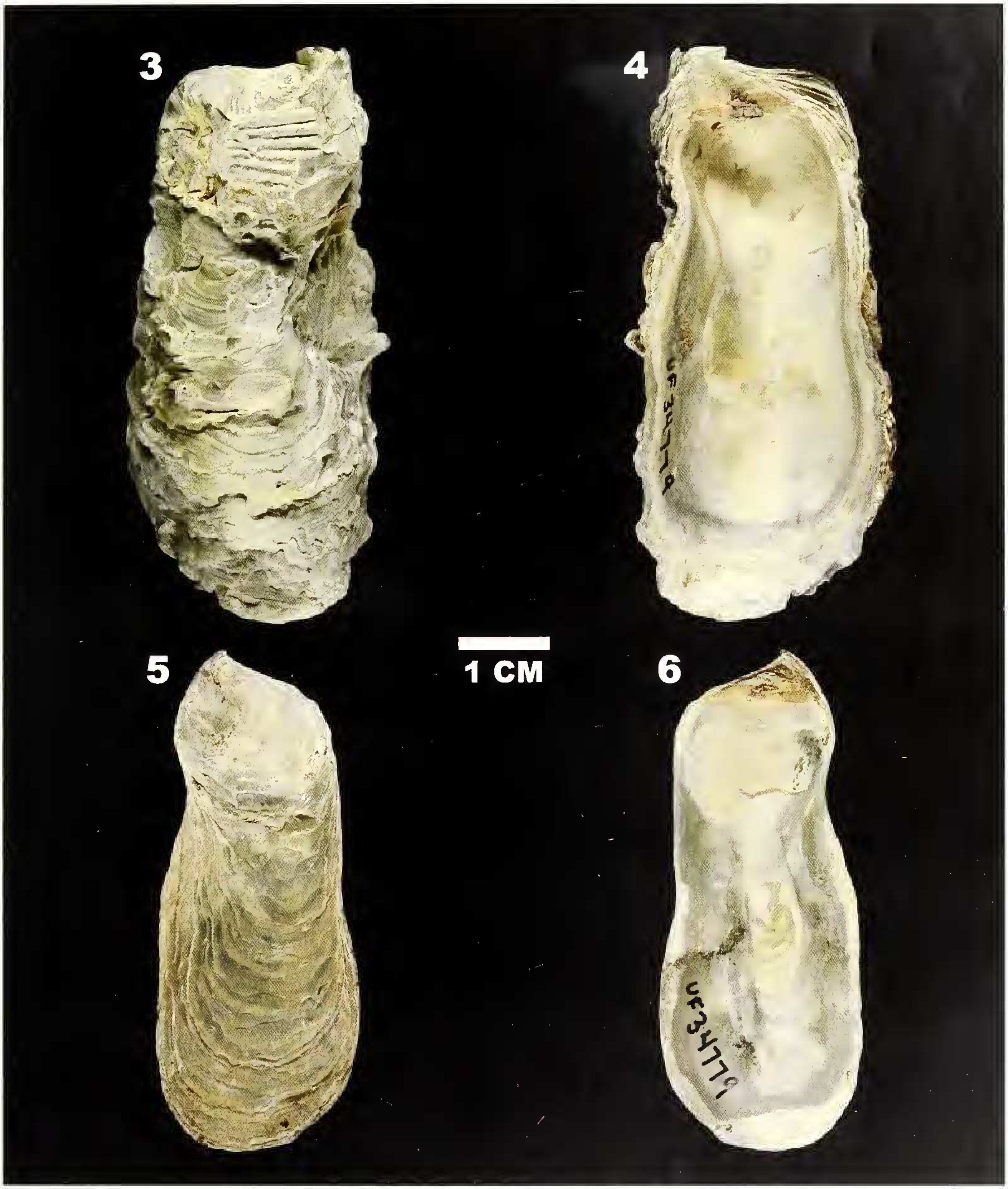
Genus *Striostrea* Vialov, 1936

Type Species: *Ostrea procellosa* Lamy, 1929, which is a junior synonym of *Ostrea margaritacea* Lamarck, 1819. Recent, along the coast of South Africa and the western Indian Ocean as far north as the Arabian Peninsula (Huber, 2010).

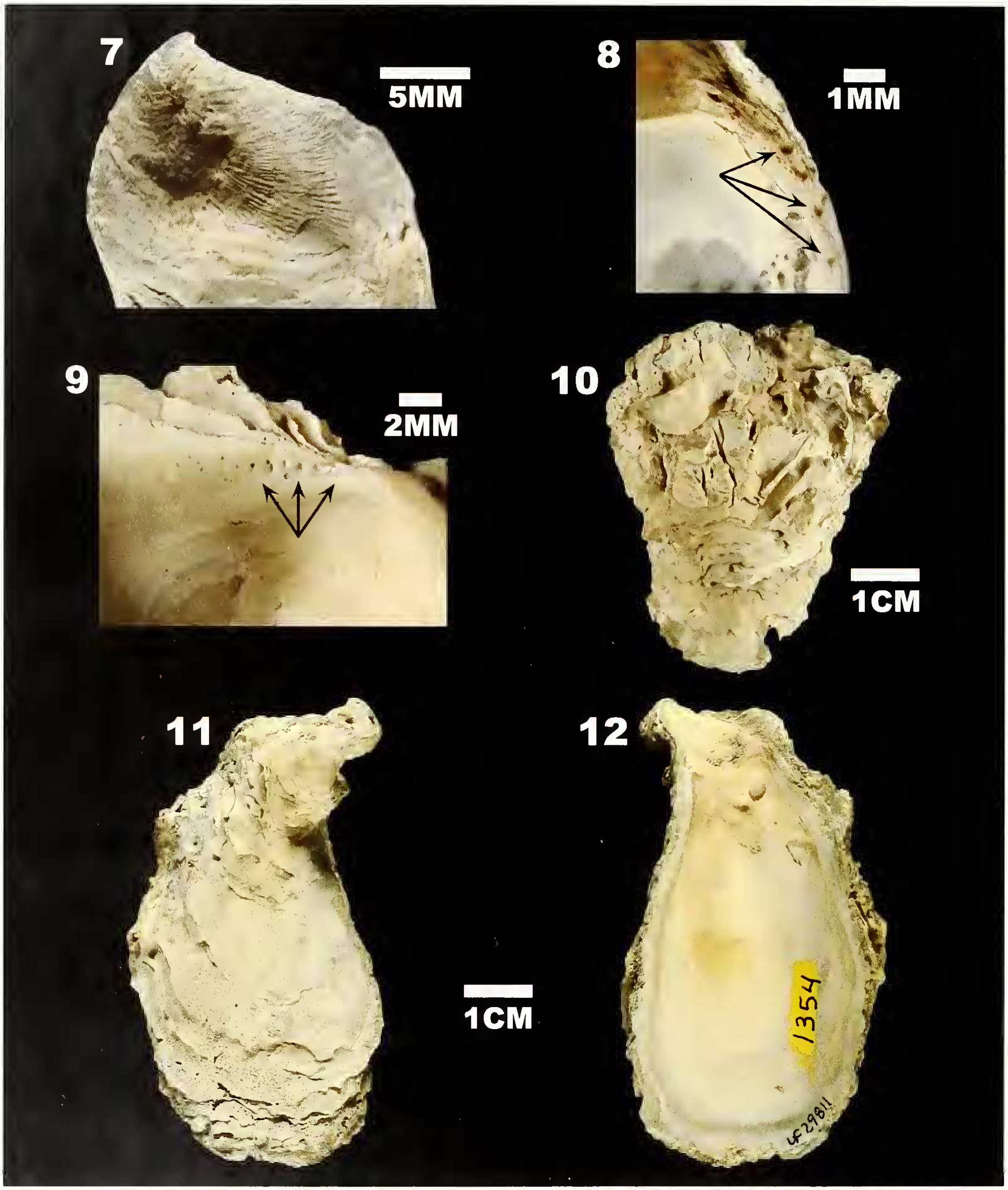
***Striostrea paucichomata* Bolton new species**
(Figures 3–12)

Diagnosis: Right valve with riblet-bearing surficial layer (only visible on exceptionally well-preserved specimens), weakly developed chomata usually present on both valves (not visible in about 30% of specimens), left valve external surface usually with characteristic irregular and undulating growth intervals, maximum height about 8 cm, posterior adductor muscle imprint situated about mid-point between ventral edge of hinge and ventral margin of shell.

Description: Shell usually elongate dorsoventrally (Figures 3–6, 11–12). Holotype maximum dimensions: left valve 6.56 cm high, 3.08 cm long, 1.72 cm wide; right valve 5.58 cm high, 2.33 cm long, 0.2 cm wide. Maximum height about 8 cm. Left valve usually without extensive attachment area; usually moderately to deeply concave; umbonal cavity weakly to strongly developed depending on degree of valve concavity; external surface usually with characteristic irregular and undulating growth intervals (Figure 3). Right valve



Figures 3–6. Paired valves of *Striostrea paucichomata* Bolton new species. Holotype (UF 34779). **3.** Exterior of left valve. **4.** Interior of left valve. **5.** Exterior of right valve. **6.** Interior of right valve.



Figures 7–12. *Striostrea paucichomata* Bolton new species. **7.** Exterior detail of right valve near hinge showing the riblet-bearing surficial layer. Holotype (UF 34779). **8.** Interior detail of right valve near hinge showing anachomata (see arrows). Holotype (UF 34779). **9.** Interior detail of left valve near hinge showing catachomata (see arrows), same specimen as Figure 10. Paratype (UF 200351). **10.** Exterior of left valve showing variation in appearance. Paratype (UF 200351). **11.** Exterior of left valve showing variation in appearance, same specimen as Figure 12. Paratype (UF 29811). **12.** Interior of left valve. Paratype (UF 29811).

usually flat; with regular, closely spaced growth lines (Figure 5); exceptionally well-preserved specimens with riblet-bearing surficial layer consistent with the description in Stenzel (1971: N979, N1136) (Figure 7), may only be present near hinge, riblets 0.1–0.2 mm wide. Both valves usually with weakly developed ostreine chomata (Figures 8–9), not visible in about 30% of specimens, only present near hinge, older specimens usually with relict chomata or chomata absent, anachomata 0.1–0.3 mm wide with 0.1–1.5 mm gap between them, chomata may be difficult to see without magnification. Shell not thick as *S. gigantissima* and *S. cahobasensis* commonly are. Posterior adductor muscle imprint situated about mid-point between ventral edge of hinge and ventral margin of shell (compared to ventral to the mid-point in *Crassostrea virginica*), usually semilunar in outline (Figures 4, 6, 12).

Holotype (Figures 3–8): UF 34779, left and right valves (pair), USA, Florida, Sarasota Co., Macasphalt Shell Pit (SO001), T36S, R18E, Plio-Pleistocene, spoil, 1 Nov. 1986, R.J. Britt, Jr.

Paratypes: UF 200351, two left valves, USA, Florida, Sarasota Co., Quality Aggregates Phase 07 (SO022), T36S, R19E, Pliocene, upper Tamiami Formation, upper Pinecrest beds, Petuch Unit 3?, 7 June 1994, R. Portell et al. (Figures 9–10); UF 216676, one left valve, USA, Florida, Sarasota Co., Macasphalt Shell Pit B (SO017), T36S, R18E, Pliocene, upper Tamiami Formation, lower Pinecrest beds, Petuch Unit 5, 16 March 1988, R. Portell and D. Jones; UF 38987, two left valves, USA, Florida, Sarasota Co., Macasphalt Shell Pit B (SO017), T36S, R18E, Pliocene, upper Tamiami Formation, lower Pinecrest beds, Section 2, Petuch Unit 6, 16 March 1988 R. Portell and D. Kendrick; UF 53225, three left valves, USA, Florida, Sarasota Co., Richardson Road Shell Pit 01B (SO013), T36S, R19E, Pliocene, upper Tamiami Formation, lower Pinecrest beds, Petuch Unit 7, 19 April 1991, R. Portell and D. Jones; UF 178522, two right valves, USA, Florida, Sarasota Co., Quality Aggregates Phase 8 REU-2 (SO049), T36S, R19E, Pliocene, upper Tamiami Formation, lower Pinecrest beds, REU Unit 2A, 3–4 June 2006, USF REU; UF 53629, one right valve, USA, Florida, Sarasota Co., Richardson Road Shell Pit 01B (SO013), T36S, R19E, Pliocene, upper Tamiami Formation, lower Pinecrest beds, Petuch Unit 8, 19 April 1991, R. Portell and D. Jones; UF 95889, one left valve, USA, Florida, Sarasota Co., Richardson Road Shell Pit 01C (SO021), Pliocene, lower Tamiami Formation, Petuch Unit 10, R. Portell and D. Jones; UF 29811, left and right valves (pair), USA, Florida, Sarasota Co., Macasphalt Shell Pit (SO001), T36S, R18E, Plio-Pleistocene, spoil, 1969–1978, E. and E. Bradley (Figures 11–12).

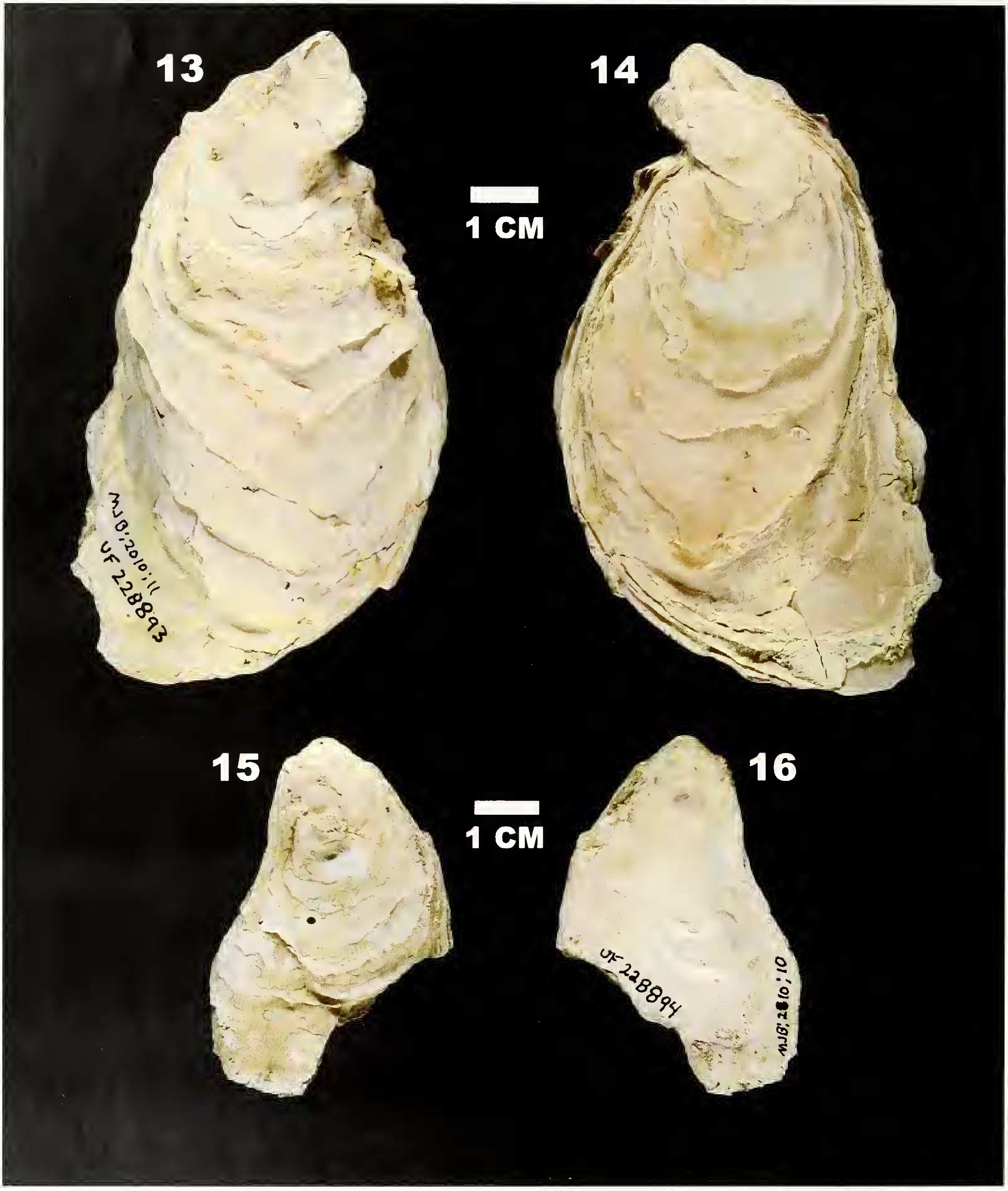
Additional Specimens from Other Locations or Formations: UF 93046, one right valve, USA, Florida, Charlotte Co., Acline Shell Pit (CH010), T41S, R23E, Pliocene, Tamiami Formation, Pinecrest beds, Florida Geological Survey/C.R. Locklin; UF 208478, two left valves, USA, Florida, Hendry Co., Interceptor Canal 01 (HN027), T48S, R34E, Pliocene, Tamiami Formation, Pinecrest beds, 1968, H.K. Brooks and D. Townsend; UF 208483, two right valves, USA, Florida, Broward Co., south of Seminole Indian Reservation headquarters, just north of lock on drainage canal (5422), Pliocene, Tamiami Formation, Pinecrest beds, 1969, H.K. Brooks et al.; UF 200355, three left valves and two right valves, USA, Florida, De Soto Co., De Soto Shell Pit 05 (DE010), T39S, R25E, lower Pleistocene, Caloosahatchee Formation, Portell Bed 7, 7 March, 1991, R. Portell and K. Schindler; UF 200354, two right valves, USA, Florida, Hendry Co., Caloosahatchee River 09, T45S, R28E, early Pleistocene, Caloosahatchee Formation, DuBar Horizon 5, 1953, J. DuBar; UF 2654, left and right valves (pair) and one right valve, USA, Florida, Hendry Co., Caloosahatchee River 01 (HN002), T43S, R28/29E, lower Pleistocene, Caloosahatchee Formation, spoil, J.C. Macbeth.

Occurrence: *Striostrea paucichomata* is known from the upper Pliocene to lower Pleistocene Tamiami Formation and lower Pleistocene Caloosahatchee Formation in Sarasota (type area), Charlotte, De Soto, Hendry and Broward counties, Florida (Figure 1). Specimens have been found at the type location in the upper Tamiami Formation, Pinecrest beds in Petuch Units 3, 5, 6, 7, 8 and lower Tamiami Formation Unit 10.

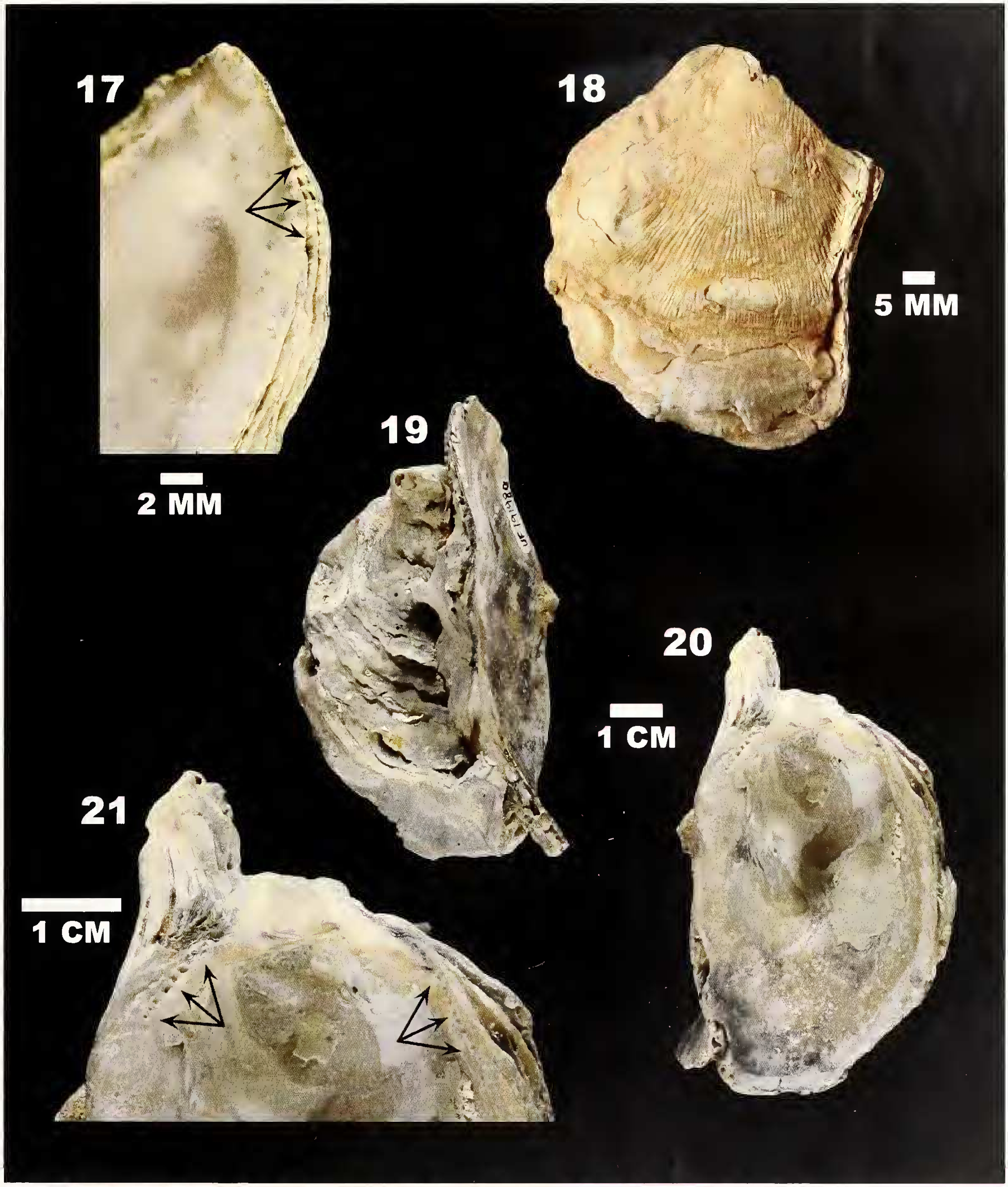
Etymology: The species name is derived from the Latin *pauci* meaning few and "chomata" which are the tubercles and pits on the periphery of inner surface of shells, usually near the hinge. This name is in reference to the usually low number of chomata that are often difficult to see or absent.

Discussion: Identification of fossil oysters has been confused and neglected due to the high amount of morphological variation associated with environmental factors. This condition has led to the publication of many synonyms based on either different ecophenotypes or the differences between young and old specimens (Stenzel, 1963). The proliferation of species names has also been the result of some authors describing new species based on a very limited number of specimens. However, given adequate material and using the characters described in Stenzel (1971) and Harry (1985), accurate generic identifications of most Cenozoic oysters should be possible.

Use of the genus *Striostrea* for crassostreine oysters with a riblet-bearing surficial layer and chomata has not been widely used in North America. This may partially be due to the riblet-bearing layer being fragile and only present on exceptionally well-preserved specimens and the chomata are not visible on all specimens either because they were only present on young specimens or are present as relict or active chomata only on a percentage of older individuals. For *S. paucichomata* these characters are also often difficult to see without



Figures 13–16. *Striostrea gigantissima* (Finch, 1824). **13.** Exterior of left valve, same specimen as Figure 14 (UF 228893). **14.** Exterior of right valve (UF 228893). **15.** Exterior of right valve, same specimen as Figures 16 and 17 (UF 228894). **16.** Interior of right valve (UF 228894).



Figures 17–21. *Striostrea gigantissima* (Finch, 1824) (**17**, **18**). **17.** Interior detail of right valve near hinge showing anachomata (see arrows). (UF 228894). **18.** Exterior of right valve showing the riblet-bearing surficial layer. (UF 228895). *Striostrea cahobasensis* (Pilsbry and Brown, 1917) (**19–21**). **19.** Exterior of left valve, same specimen as Figures 20 and 21 (UF 191980). **20.** Interior of left valve (UF 191980). **21.** Interior detail of left valve near hinge showing catachomata (see arrows). (UF 191980).

magnification. For these reasons, to accurately identify fossil *Striostrea* it is important to have sufficient numbers of exceptionally well-preserved specimens including ones of different age classes.

Fossil *Striostrea* known from the western Atlantic include *S. gigantissima* (Finch) (lower Eocene through upper Oligocene; USA: North Carolina–Texas), *S. cahobasensis* (Pilsbry and Brown) **new combination** (upper Oligocene through middle Miocene; Caribbean: Venezuela, Panama, Puerto Rico, Haiti, Mexico; USA: FL), and *S. paucichomata* Bolton new species (upper Pliocene through lower Pleistocene; USA: FL). Photos of young specimens of *S. gigantissima* (Figures 13–18) from the upper Eocene of Georgia and *S. cahobasensis* from the lower Miocene (Figures 19–21) and upper Oligocene (Figures 22, 23) of Florida are provided for comparison. A key for the Cenozoic crassostreine oysters known from southeastern United States is provided below. There are also specimens of a large crassostreine oyster in the FLMNH Invertebrate Paleontology Collection from the Pliocene of Curaçao (an island off the coast of Venezuela) that may be a *Striostrea*. Young specimens have chomata (UF 114702, UF 116000, UF 116005), but no surface riblets were present on the right valves. However, the specimens were not sufficiently preserved to exhibit a riblet-bearing surficial layer. Furthermore, they very much resemble the eastern Pacific species *Crassostrea titan* (Conrad, 1853) in shape and size. Additional study is required to determine if they are conspecific. The complete temporal and paleogeographic distribution of *Striostrea* will not be known until museum collections are reexamined using the characters and caveats discussed in this paper. Four living species of *Striostrea* are known from the eastern Atlantic Ocean along the coast of tropical West Africa, the coast of South Africa and western Indian Ocean along the coast of East Africa as far north as the Arabian Peninsula, northern Pacific Ocean from Japan to Taiwan, and tropical eastern Pacific Ocean (Huber, 2010).

Key to Cenozoic Crassostreine Oysters Known From the Southeastern United States:

1 Shell without chomata; right valve without a riblet-bearing surficial layer (visible only on exceptionally well-preserved specimens); shell may have costae (primarily on the left valve) and may have plicae along the ventral margin; posterior adductor muscle imprint usually situated ventral to the mid-point between ventral edge of hinge and ventral margin of shell; upper Oligocene – present. .... ***Crassostrea virginica* (Gmelin, 1791)**

1′ Shell with ostreine chomata (may be absent in older shells and various ecomorphs) (Figures 8, 9, 17, 21, 23); right valve with a riblet-bearing surficial layer (visible only on exceptionally well-preserved

Figures 22–23. *Striostrea cahobasensis* (Pilsbry and Brown, 1917). **22.** Exterior of left valve, same specimen as Figure 23 (UF 27389). **23.** Interior detail of left valve near hinge showing catachomata (see arrows). (UF 27389).

specimens, especially younger ones) (Figures 7, 18); shell usually without costae or plicae. **2**

2(1′) Both valves of similar convexity (especially old shells) or left valve slightly to moderately more convex and capacious; maximum shell height about 56 cm; shell may be extremely thick (see Harris, 1919: Pls. 1–6; Howe, 1937: Pl. 44 Figs. 1–6; Toulmin, 1977: Pl. 14 Figs. 5, 6, Pl. 15 Figs. 1, 2, Pl. 56 Fig. 7); lower Eocene – upper Oligocene. . . . . . ***Striostrea gigantissima* (Finch, 1824)**

2′ Left valve usually more convex and capacious than right valve; maximum height less than 20 cm. **3**

3(2′) Chomata moderately developed or absent (Figures 21, 23); shell maximum height about 19.5 cm; shell may be thick (see Pilsbry and Brown, 1917: Pl. 6 Figs. 1, 8; Woodring, 1982: Pl. 90 Fig. 21, Pl. 93 Figs. 6, 7, 9–11, Pl. 94 Figs. 1, 3, 5, Pl. 102 Figs. 1, 5, Pl. 103 Fig. 8, Pl. 106 Figs. 2, 6, 7); upper Oligocene – middle Miocene. . . . . ***Striostrea cahobasensis* (Pilsbry and Brown, 1917)**

3′ Chomata weakly developed or absent (Figures 8, 9); shell maximum height about 8 cm; shell not thick (Figures 3–6, 11–12); upper Pliocene – lower Pleistocene. . . . . ***Striostrea paucichomata* Bolton new species**

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